Sedimentation, Wettability, and Fluid Flow in Uncompacted Sand Columns

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Introduction: We are interested in investigating the microstructure of sediments as the basis for modeling the microgeometry for application to fluid flow calculations. Theoretical models of the sedimentation process have been developed by Coelho et al. (1) and Quintanilla and Torquato (2) that predict values for quantities such as the 2-point correlation function, conductivity, and permeability. Experimental investigations of sediments can be made using computed microtomography and the results compared to the theoretical predictions.

Methods and Materials: The initial measurements were carried out on sieved samples of sands from Cancun, Mexico, in the size range from 0.250 to 0.500 μm. These were contained in a plastic tube with provision for adding and draining fluids so that the wettability and interfaces between the different fluids used in the experiment, air, iodooctane and water, could be measured. The relatively large grain size was chosen to facilitate identification of pore space and grain surfaces. The work was carried out with a third-generation apparatus for computed microtomography at the X27A beam line. The voxel size was about 0.010 mm. Tomographic volumes were obtained for a column of dry sand. Then, sedimentation was simulated by filling the tube with liquid and sand and letting the sand settle after shaking. To achieve a two-liquid phase distribution in the pore space of the sand columns, a non-wetting fluid was forced through the sand columns: water in the case of iodooctane-wet sand and iodooctane in the case of water-wet sand. The resulting pore-space fluid distribution was analyzed.

Results: This initial investigation yielded a number of tomographic volumes and radiographs of the sand column for different conditions of the fluids in the sand column. Work on comparing this data to the theoretical predictions is now in progress.

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References: 1. D. Coelho, J.-F. Thovert, and P. M. Adler, “Geometrical and Transport Properties of Random Packings of Sphere and Aspherical particles,” Physical Review E, **55**, *1959*, 1997. 2. J. Quintanilla and S. Torquato, “Microstructure Functions for a Model of Statistically Inhomogeneous Random Media,” Physical Review E, **55**, *1558*, 1997.